A STUDY OF THE CARDINAL IN TENNESSEE [1]

BY AMELIA R. LASKEY

DURING the years 1931 to 1943 I made a study of the Cardinal (*Richmondena cardinalis*) in the Nashville, Tennessee area, banding a total of 1,621 birds, and gathering data on habits through the year, nesting, seasonal movements, weights, longevity, and abnormalities. A number of individuals were color-banded, and detailed observations made on two distinctively banded pairs.

Song

The first songs of immature Cardinals are very soft warblings, totally unlike adult song: these "indefinite" warblings are called "ancestral," "primitive," or "tribal" by various authorities (Nice, 1943:42). I have records for four young Cardinals singing in August, two wild birds and two hand-raised, free-flying females. One of the latter began warbling at three weeks of age, the other at four weeks. One of the wild birds (probably a female) appeared to be about a month old; the other, a male nearly two months old, used some adult phrases in his lengthy warbling performance. "Reddie," one of the hand-raised females, added two adult songs to her warbling in early October, when she was slightly over two months old (Laskey, 1937:68). By late January and February her songs were indistinguishable from those of adults.

Jesse M. Shaver gave me the following notes on the song of the adult: "Cardinals have a great many songs, at least 16 common ones. There is a good deal of difference in the singing of individual male Cardinals. There are times when the female seems to sing more softly than the male [See Ganier, 1941:1], but this is not always or even usually the case. I think it would be wise to say that there is no more difference between the song of the male and the female than between different males. The female begins her song much later in spring than is the case with the male. After nesting begins, her song is quite different from that of the male and is often uttered on the nest. Always the male comes to her after the song and often feeds her. The female also sings when she wishes copulation to take place. The male responds to this song by appearing and copulating with her. At other times the female sings and the male sings in answer but the male does not appear."

In 1942, from June 28 through most of July, I kept a record of songs and variations heard from Cardinals about my home and in Warner Parks, using phonetic syllables to designate each song as it sounded to me. There were 28 different songs of two to six syllables each.

[1] To Mrs. Margaret M. Nice and to J. Van Tyne, I wish to express appreciation for their suggestions and editing during the preparation of this material.

The songs of the two sexes seem to me to be alike, but the male's singing season is longer than that of the female. In Tennessee, his clear ringing whistles are heard in January and February, sometimes when snow is still on the ground, whereas female song usually starts in March, when Cardinal song is heard on all sides. "Reddie" sang in December and January, but she spent much of her time indoors during the cold weather, which apparently advanced her singing period to some extent. Shaver and Roberts (1933:118) mention a female that sang in mid-February while she was being courted. There is considerable singing during July and August, when the bird is so well concealed in the foliage that sex identification is difficult. But in most cases where identification was certain, the singers were males. In August, 1943, a female sang a few songs as she perched in a tree near her nest, which at that time contained two young, eight days old. Although I have records of Cardinal song for every month of the year in Tennessee, there are very few for November and December—in some years I heard no Cardinal singing at all during these months. In Oklahoma, Nice (1927:103) found the Cardinal's season of full song began in early February and extended to late July.

Adult birds may sing an almost inaudible song ("whisper" singing) during the months of courtship and mating, January to April. This type of song is mentioned by Shaver and Roberts (1933:118) as part of courtship behavior in January and in April. In February (Laskey, 1935:1), as a mated pair investigated nest sites outside our windows, I heard very soft songs, described in my notes as "woit-woit," "de-ar," and "almost inaudible trills." Nice (1927:101) heard the whisper song in September.

There is considerable antiphonal singing between a pair during courtship as well as during nesting. At my home a male sang from a tree, and the female answered, as she incubated or brooded in the nest 150 feet away. Apparently the songs were signals between the pair, for her songs often preceded a flight from the nest to meet the male 15 or more feet away, where he fed her.

During April, May, June, and July, I have heard Cardinal songs in the night (Laskey, 1935:2). They have never been lengthy, like the night performance of the Mockingbird, but merely a few repetitions of "tu-er" or similar sounds heard in the daytime repertory. Because Cardinals like to roost about the house or garage, usually on service wires under eaves, in porches, or in foundation shrub plantings, it is particularly easy to hear these short songs on many successive nights.

Shaver and Roberts (1933:118) described song and courtship of a pair of Cardinals (involving the female cited above), which sang against each other from mid-February until nesting time, the male repeating songs after the female, changing usually as she did, often singing in unison with her. This the authors consider part of courtship, with "protective value for the territory in warning other Cardinals that it was

occupied." They describe the type of behavior common in March and April, when singing in both sexes is accompanied by swaying of the body with neck elongated and crest raised. Another courtship ceremony is sometimes followed by coition. "The male . . . with his crest, neck and body extended and singing very rapidly . . . may step sideways down the limb to the female. During this time he appears fairly to slide down. Arriving at the female, he may put some food into her mouth" (p. 119). Song was a "queer gurgling attempt" as the male flew after the female following one such ceremony. When coition followed, the female then sang a "weird" song as she walked sideways down a limb and away from the male (April 24). This pair had a nest soon afterward and the first egg was laid May 2.

Territory and Dominance

Courtship pursuits begin soon after the reappearance of full song early in the year. On mild sunny days of late February, there is considerable evidence of the beginning of territorial activity. Males sing from rather high perches in trees about a hundred yards apart. There are many pursuits at low elevations when males pursue males, and females fly after females. Sometimes three males fly in single file, but usually only two individuals of a sex are involved in these rather leisurely flights.

The groups and loose flocks, formed during fall and winter, disband gradually as males choose territory and obtain mates. (Generally these groups have been fairly even in sex ratio, but occasionally the proportion of males is somewhat greater; in December, 1943, the flock at my home had an unusually large proportion of males, 10 to 2; February 1, there were 6 of each sex in the flock.) Occasionally a mixed group may still be found feeding together in mid-March, but by late March, most of them are settled on territories with only occasional intrusions by unmated individuals.

Cardinals do not defend territory so pugnaciously as Mockingbirds, for example, do, but there is some mild fighting in spring. A mated male will fly at an intruder of his own sex; a mated female will chase another female, but each is usually tolerant of the opposite sex, never becoming an ally of its mate against the intruder. At my home, in the spring of 1935, an unmated male frequently trespassed on the territory of the "Old Pair" (mated since 1933) to court the female, but the mated male always drove him back to his own side of the lot. In April of another season, a female arrived and began singing as she perched about 20 feet up in a tree near our house. Immediately a mated pair flew to the tree, and that female flew at the singer, causing her to stop singing and leave, with the mated female in pursuit. In March and April, 1937, a female several times drove another from the vicinity of her nest while the male showed no animosity (Laskey, 1937:68). I have observed Mockingbirds

and Bluebirds in this same type of territorial defense. Brooks (Christy, 1942:185), however, reports a female Cardinal who during the breeding season was "often intolerant" of the presence of a male at the feeding shelf.

"Shadow-boxing" is occasionally practised by Cardinals of both sexes. An individual will fight its own reflection in a window pane for long periods on many successive days while the mate perches quietly in a nearby tree. W. R. Reed (1938:17) reports a female in east Tennessee flying at its reflection during January; she was sometimes accompanied by a male "which behaved as a bystander." In Nashville, a male spent much time in March dashing at his own image in a window while the female watched. Harry Yeatman (1936:22), of Columbia, Tennessee, reports a male that in winter drove all Cardinals from his territory and spent many hours in the day fighting his reflection in the upper windows of the house.

Cardinals, in Tennessee, are only mildly belligerent, and one seldom sees a fight involving them. Towhees, in my experience, fight oftener among themselves over food in winter, and Chipping Sparrows fight more desperately over territory in spring, than Cardinals do. However, in October, 1943, I saw two male Cardinals fly at each other, striking beaks as they came together three or four times. Again in December, a male ran at other males, striking one with his beak.

In my feeding program, food is widely scattered on the ground, hence the behavior would not exactly parallel that on a feeding shelf, where the food is concentrated in a small space. At her feeding shelf in Oklahoma, Mrs. Nice (1927:102; letter) found some of the males much more despotic than those which came to her shelf in Ohio. In all cases, the winter males dominated the females, but in Ohio she found the despotism mild. She tells me that "females in Ohio showed more animosity towards each other in connection with the feeding shelf than did males toward each other or toward the females. . . . In Oklahoma all males drove Harris Sparrows; some males drove all smaller birds. All gave way before Mockingbirds and a Robin." In winter, I find some Cardinals of both sexes drive off House Sparrows but usually ignore smaller birds (See also Maurice Brooks, quoted by Christy, 1942:185). They are sometimes dominated by Towhees, by Mockingbirds, and by Blue Jays.

The female of a pair tends to follow her mate after the breeding season and through the winter, but in autumn, males become mildly dominant when feeding, keeping the females in the background by running at them. The male of the Old Pair might run at his mate of three seasons if she came too close during November and December, and she remained a yard or so behind him as they fed on the lawn (See also Maurice Brooks, quoted by Christy, 1942:185). He was not seen feeding her until March, but in January and February, he permitted her to feed within a few inches of him.

Feeding of the female by the male, a common occurrence in March and April, is sometimes observed in January and February (Ganier, 1941:1), but usually starts in March. In 1936, Ganier's (1937:15) Cardinal, then 13 years of age, started feeding his mate in February. The female assumes the begging posture, quivering both wings like a juvenile bird. In the section on the nesting of "Y" and "B" in this paper, more details are given on the begging of a color-banded female. Feeding of the female gradually ceases as the young need attention and the male is occupied with them.

Nests and Nesting

Cardinals usually begin laying in April. A. F. Ganier (1941:2) states that his earliest record around Nashville is a completed set of 3 eggs on April 3, but I have five records of eggs laid in March, four of them from 1938, when a period of spring weather occurred unusually early. In 1935, three eggs were being incubated April 1; in 1938, a set of three was being incubated March 28 and three broods of two, one, and two, were banded on April 16, 18, 19, respectively, when they were at least five days old—indicating that egg laying started in March.

The nesting season may extend into August and September. I have 13 records of young still in the nest during those months. In addition, I have trapped from late September to December 14 a number of unbanded immatures whose beaks were still dark, an indication that they were August or September nestlings, since the beak assumes the red color of the adult in 65 to 80 days (though a dark tip about a millimeter in width is sometimes retained in the upper mandible for several months). On October 6, 1941, a young Cardinal three to four weeks old was still being fed in Centennial Park by the mother.

Since 1932 I have found a total of 103 Cardinal nests in the Nashville area. As nest sites, Cardinals choose young evergreens of many varieties; privet hedges; many species of vines, including rose and honeysuckle; shrubbery; and saplings of hackberry, elm, hawthorn, and locust. I have found them from 2½ to 12 feet from the ground, but 4 to 5 feet is the usual height. Shaver and Roberts (1930:167) report one 8 inches, and two 15 feet, from the ground. Most nests are concealed in forks of twigs and small branches or in mats of vine stems, but one at my home was built upon a platform of twigs which I had placed in a privet shrub where the pair had tried to anchor material in unsuitable forks. Another was built on the ledge of a lattice fence between poultry wire with nothing for concealment. Alfred Clebsch (1943:38) found one in Clarksville, Tennessee, in a rustic building behind some lattice work. Among 103 nests studied by Shaver and Roberts (1930: 160), two atypical sites were found which lacked the usual foliage concealment; one was placed on the north side of a house, and the other against the trunk of a honey locust tree on the branching thorns below the limbs. They cite one photographed by Harry Vaughn, of Nashville,

in April, 1921, which was placed on a dirt shelf among tree roots in a gully. E. Copeland (1936:83) describes a Cardinal nest built in a feeding shelf outside a second-story window.

Nests are composed most commonly of weed stems, small pliable twigs, strips of bark, grasses, vines, and rootlets, with leaves and paper interwoven. They are bowl-shaped, some compactly built and well-lined, others very flimsy with scarcely any lining.

I observed the building of three nests from the start; one was begun April 6, 1931, completed April 10, first egg laid April 16; one started April 1, 1934, was completed April 4, first egg laid April 9; another, started April 7, 1937, was completed by April 16 (perhaps earlier), and contained its first egg on April 22. The male assisted in building one nest; the females built the other two without help. Sometimes the male attends his mate as she flies back and forth with material. Ganier (1941:1) states the male sometimes brings material which the female takes from him. Sutton (1941:274) states that "Crousty" built her first nest in late June, 1937, when she was less than 11 months old. She built it by herself while the male sang and fed her. "The nest was a good one, neat, compact, well lined." She had been hand raised and released in the spring at Ithaca, New York, where she and her mate, a wild bird, were the only two Cardinals in the countryside. Shaver and Roberts (1930:163) also state nest building is usually by the female with the male sometimes accompanying her or singing in a nearby tree, but they observed two nests where the male assisted in building.

Shaver and Roberts (p. 157) report that a pair may build five nests in a season, though usually not more than four broods are reared successfully. In 1934, at my home, the Old Pair started nest building on April 1, and that season had four nests, three of which were successful; six young were raised. In 1935, the same female again had four nests, with three successful. The first brood of two left the nest April 22; the second nest was robbed. About that time, the male of the pair, now mated for three seasons, disappeared, and the female mated with the green-banded male ("G") that had occupied the other half of the lot, had courted her in spring, and had been chased back by her mate. She remained in her old territory where she and "G" had one nestling leave on June 11 and two on July 30. Her nesting routine had not been affected by the loss of her old mate and the acquisition of a new one in mid-season, for she raised that season five young from three successful nests in four attempts. A sixth nestling was killed by a Blue Jay the day its nest mate was fledged. (Laskey, 1935:62.)

The number of eggs in a set is commonly three, but in Oklahoma, Mrs. Nice (1931:173) found that among 36 nests with at least three eggs, 28 per cent had more than the usual complement: nine had four eggs, and one had five. Ganier (1941:2) states that around Nashville about one in 30 nests has four eggs and that late in the season a full complement may be two eggs. Christy (1942:182), in Pennsylvania,

in four nests studied, found one with four eggs. Excluding nests found with less than three eggs or young, which may or may not have been complete sets, I have records for 35 nests during the years 1937 to 1943. Of these, three had four eggs each (8.5 per cent).

In 1943 a set of three was completed April 16; incubating had started with the set still intact at 8:15 A.M. on the following day, but at 5 P.M. one pierced egg was found on the ground about four and a half feet away. A pair of Cowbirds had been lurking in a tree above the nest, but none of their eggs appeared in the nest, and no further depredations occurred there. In Johnson City, Tennessee, Robert B. Lyle (Woodring, 1932:38) found the first Cowbird eggs he had recorded from that area in April, 1932, in a nest of the Cardinal which contained three of its own and two eggs of the Cowbird. H. C.Monk (1936:33), when compiling a list of species parasitized by Cowbirds in the Nashville area over a period of 19 years, stated: "Local students have examined thousands of Cardinal nests with only one Cowbird record, indicating how very rarely this species is parasitised." This scarcity of records might be taken as evidence that the Cowbird is a rare breeder in Tennessee, as reported by Ganier (1933:39), but I have records for 1938 to 1942 of nine Cardinal nests with one Cowbird egg in each. In 1942, among 16 nests of this species, four in April and one in June were parasitized and contained less than the usual complement of Cardinal eggs. Previously I had found Cowbird eggs in two sets of three eggs and in one set of four eggs.

In one nest which I observed, the Cowbird egg hatched a day ahead of the single Cardinal egg, but both nestlings were taken by a predator. In another nest, the two Cardinal eggs and the Cowbird egg hatched on the same day. The Cardinals left at 9 days, but the Cowbird remained in the nest until 11 days old.

Incubation of eggs and brooding of young is by the female exclusively. In August, 1941, after I had removed two nestlings from a nest eight feet up in a privet hedge, the female hopped into the empty nest and sat in it, as if brooding, during the entire time the nestlings were being banded nearby. She was not deterred by the presence of the ladder or of the people.

I found incubation periods of 12 and 13 days, computed from the date of laying of the last egg, when incubation starts. Mrs. Nice (1931: 173) reports 12 days for nests in Oklahoma. The young may leave the nest at 7 to 11 days of age, but usually at 9 to 10 days.

During incubation, the male feeds the female, usually when she is off the nest. He brings food to the nest for nestlings and often assumes full charge of the fledglings when the female begins a new nest. He feeds the young until the next brood is hatched; then he repulses the older birds by flying at them with scolding notes. The last brood of the season is often divided between the pair for attention.

Although a large part of the food of adult Cardinals consists of

seeds and wild fruits, the nestlings are fed exclusively on insects. A hand raised Cardinal began to pick up food after 13 days out of the nest; another began after 20 days, at that time readily eating a corn-ear worm, first crushing the head, and passing it back and forth in its mouth a few times, before swallowing it head first. Cracking sunflower seeds was not successfully accomplished by "Reddie" until she was nine weeks old.

One hand-raised Cardinal dropped a pellet in the cage when brought indoors overnight at five to six weeks of age. The pellet was 15 mm. long, 8 mm. at its widest and tapering to a point, consisting of husks and seeds of millet. Among my hand-raised fledglings of other species, pellets were dropped by the Crow, Orchard Oriole, Mockingbird, and Bluebird.

Cardinals are not particularly fond of bathing, but "Reddie" (Laskey, 1937:68) bathed indoors occasionally; and on March 1, she took a prolonged bath, getting her plumage very wet, in a tiny gutter outdoors, with temperature around freezing and a light snow falling. One year in January, I observed Cardinals and Juncos bathing in small puddles formed by the melting snow. Christy (1942:177, note) states Cardinals are seldom seen at the bird bath; Mrs. Nice (1942: 187) says she has seen females bathe fairly often but knows of only one record for a male.

Nest of Y and B

In April, 1937, considerable data were accumulated from a nest of a resident color-banded pair built in the privet shrub by the house. The female, "Y," was banded in January, 1936, and was last trapped in June, 1939. Her mate, "B," was banded April 5, 1936, and was last seen in August, 1937. The nest was built six feet up, almost opposite a breakfast room window and under a high kitchen window.

Nest building started April 7; all material was brought in and placed by the female. Her mate followed her closely but was not seen assisting. The nest was complete by April 16 or earlier. That day the female was found in the nest at 7 A.M. (C.S.T.) but did not lay the first egg until April 22; the set of 3 was completed April 24, when incubation started. Fearing she might desert, I made no lengthy observations during incubation, but some notes were taken from spasmodic watching, as follows: April 26, "Female sings frequently, rather loudly, while incubating. Male sings from a distance of 150 feet. Songs alternate as if in answer." April 28, "Loud singing by female several times today, apparently to attract the male, for he answers. Her calls came shortly before she went off the nest. Male always met her at some distance from the nest. At several observations, she came back to nest, looked into it, left for short periods of a minute or so before settling." May 23, 6:25 A.M., "Male came to the nest with a moth. From perch on a twig

beside the nest, he passed it to the female, who left nest with it, flying to driveway curb 15 feet away to eat it. Male remained, hopping on twigs, looking into the nest while making soft clucking sounds. Female returned in five minutes, 'chipping.' She settled on eggs briefly, left, and returned immediately to incubate. Loud songs were given by her at 6:40, 6:45, 6:50 A.M. She flew off for 5 minutes at 7:15. She sang again at 7:35 A.M. The various Cardinal songs were used." May 4 (drizzling rain), 8:04 A.M., "Male called 'Woit, woit' several times. Female answered with same calls but fewer in number. Performance repeated.—8:16, Female off for 3 minutes, returning with 'chips,' leaving again before settling.—9:25 A.M., Off. Met male on driveway. Back in 2 minutes, looked at nest, flew off. Repeated, 'chipping' entire time. Settled at 9:35."

On May 7, the first nestling was hatched by 6:30 A.M. and the other two by 8 A.M. (13 days incubation). Young were seen raising heads within a half hour after hatching. Twice the female was noted eating egg shells; she turned and crushed the halves in her beak before swallowing. Apparently none was carried away. Observations were made during the nine days of nest care in periods irregular in length, and at varying hours of the day; yet they give a picture of the progressive phases of nest life. The first morning, the female alone fed the young, although during her short periods away from the nest the male may have given her food elsewhere. That afternoon he brought food to the nest, which he fed to the young in the absence of the female, but when she was at the nest she tended to monopolize this part of the care and begged the food from the male. Twice he passed it to her for feeding, but later in the day he ignored her begging and fed the young himself. On the second day (May 8) during mid-day observations, he brought food five times, and offered it to the young, but it apparently was unsuitable; some of it he ate himself and some the female swallowed. On May 10 (young three days old) both parents were kept so busy feeding that their visits alternated, each feeding in turn. May 11 the female was again seen begging the food from her mate. He gave it to her once but the other times ignored her. After that day no begging by the female was seen.

To feed the nestlings, the female perched on the nest rim, but the male was never seen on the nest. He always fed the nestlings from twigs adjacent to the nest. During the first days each parent announced its coming with the typical Cardinal "chip," but from the afternoon of May 11, when the nestlings were four days old, the parents were usually silent; the young had then become alert and were ready for the food at the arrival of a parent. On May 14, when the young were seven days old, their chattering food call was first heard. Each time a parent arrived in the shrub, the young stretched high in the nest and chattered. On May 15 they preened their breast- and wing-feathers. The entire body quivered in their eagerness for food from the parent.

At 7 A.M., May 16 (at nine days old), one was perching in the nest shrub, and by 8:30, the other two had joined it. During that day the parents spent much time in a nearby silver maple, where, from the low-sweeping branches, they obviously coaxed the young, trying to lure them away from the nest site. There were many trips from tree to shrub and back to tree, punctuated with "chips." Only a relatively few of these trips included feedings. At one time the female faced the young from the tree, singing "tu-er" repeatedly, changing to "de-ar bird," and back to "tu-er" again. Finally by 4:30 P.M. all three young had left the nest shrub; they were unable to fly, but they made their way across the front of the house, some 60 feet, to the privet shrub at the other side, where they spent the night. On June 10, the male was feeding three apparently full-sized immatures at the rear of the house; June 15 they were seen following him but not fed. June 19 and 25, one of the brood, a male, was taken in a banding trap near the house.

The nesting activities of the pair were not followed the rest of the season, but on July 23, the male was feeding a large immature of their final brood of the season. August 5, these adults were not far apart, the father feeding a dark-billed female and the mother followed by the immature male. Both these young had been caught in banding traps before this date, proving that they were already foraging to some extent for themselves. August 15, the adult male was busily repulsing two begging young by running at them, flipping his wings, and giving the short "pfitt, pfitt" scolding notes as they followed him with fluttering wings and jingling begging chatter.

In 16½ hours of observation of three young from hatching to the day before nest-leaving, the female fed the young 56 times, the male 45. In 6¼ hours during the first two days, the young were fed 3.3 times an hour; in 5½ hours during the next two days, 8 times an hour; in 3 hours on the fifth day, only 3 times an hour (this low figure being correlated with showery weather and much brooding), while in 1⅔ hours during the last two days, they were fed 11 times an hour. During the observation periods, the female brooded about two-thirds of the time during the first two days, about one-third during the next two, two-thirds on the showery fifth day and none at all after that during the daytime. The female gave the young their last feeding on the second day at 6:30 P.M. (C.S.T.) and on the third day at 6:53 P.M.; on both these evenings she settled for the night immediately after the feeding. On the third day she fed the young at 6:53 and settled at 6:55. On the seventh day she settled at 7:50.

Harvey (1903:56) says the parents feed the young insects at first by "regurgitation." My observations furnish no evidence to that effect; the insect food brought was often very tiny, but it obviously was carried in the mouth or beak and rolled many times in the beak before being fed to the nestlings.

Both parents cleaned the nest, but the female displayed more concern by waiting and searching for fecal sacs. She swallowed some until the fifth day and the male ate some until the fourth day; after that all were carried off.

Individual Range of Cardinals

A total of 1,621 Cardinals were banded at my home and in Nashville, and at several sub-stations (operated with the help of friends) [2] between September, 1931, and August, 1943. The records from these 12 years of systematic banding indicate that the Cardinal is not only a permanent resident species in the Nashville, Tennessee area, but also that individuals range no more than a few miles during their lifetime.

Eighty-five individuals, or 5.24 per cent of the total number banded, have been caught or found dead from one to six years after the banding date. Most of these birds were found in the immediate neighborhood of the banding place, and none was found farther than four miles away.

There are numerous records of banded individuals that remained in the same area for several years. Among them are a color-banded pair which remained as resident mates at my home for nearly three years, and a color-banded male that lived there from September, 1937, until killed by an automobile near our driveway in May, 1943. A male banded at my Love Hill sub-station in October, 1934, was caught in the same neighborhood in March, 1940. (Unfortunately, the finder removed the band before releasing the bird, so that further knowledge of this old bird is unobtainable.) In addition, there is the well-known male banded by A. F. Ganier (1937:15) at his home in February, 1924, and seen there regularly until its disappearance in November, 1936.

The greater number of my Cardinals have been banded in autumn and winter. From September into March, groups or loose flocks of from 6 to 25 birds gather at good feeding places. It became apparent during the second year of my banding (1932) and has been noted many times since that, while the total number of individuals in a given flock may remain fairly constant, the flock is not always composed of the same individuals (Laskey, 1934:117; Ganier, 1941:4). Throughout the season unbanded birds continue to arrive, and some banded birds disappear, often returning at some later date or subsequent winter season. These returning Cardinals reappear at irregular intervals. Their movements do not coincide with the rhythmic appearance and disappearance which my banding records have revealed for the Field Sparrow (*Spizella pusilla*), another species which has been considered a permanent resident (Laskey, 1934:172).

Among Cardinals, one plausible explanation of the fall grouping and wandering of a large part of the local population, while certain individuals and pairs remain on their nesting grounds, is that these

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[2] Grateful acknowledgment is made to M. S. Carter, A. F. Ganier, Mrs. E. C. Hicks, A. A. McMurray, M. L. Rippy, Jr., Mrs. E. C. Tompkins, and others.

groups are composed mostly of young birds hatched during the year (though the flocks doubtless also include adult birds that have left their breeding territories for various reasons such as lack of food and shelter). It is difficult in autumn after the molt to distinguish young from adult birds, but I have a few banding records as evidence. Several years ago I was operating sub-station "Shadows" at the home of Mrs. E. C. Hicks, three-quarters of a mile southwest of my home, and found that flocks congregated there each autumn and winter. They were attracted by the supply of hackberries and sunflower seeds, their favorite winter foods, and particularly by a dense canebrake about a tiny creek. Among the banded birds taken there, were some that had been banded as juveniles at their birthplaces. In February, 1933, I caught a male that had been banded in May, 1932, in a nest half a mile east; a female that had been banded in September, 1932, in a nest about two and a half miles north; and one unbanded male whose spotty plumage and short tail feathers indicated he was probably one of a very late 1932 brood. A young male, banded at my home in August, 1933, and retrapped there in September, was trapped at Shadows in November. In late December, 1935, another young male was taken at Shadows that had been banded in the nest of the Old Pair at my home. He had left the nest June 11, 1935. He had remained in our garden until he was at least six weeks old, for he was taken in banding traps July 8, 11, 12, and 13. In January, 1940, another male was trapped at Shadows that had been banded the previous August in immature plumage at my home and retaken there in December, 1939 (and that was again taken there in January, 1944). Therefore the Shadows flock had harbored at least six individuals that are positively identified as young birds, four of which are known to have hatched from one to two and a half miles away. Another young Cardinal with beak still dark was banded at the home of a friend in September, 1935, and was retaken on December 14 at my Love Hill sub-station about a mile from its birthplace.

Among my records are four which give an idea of the short distance traveled between birthplace and breeding area. Male No. 38-210161, banded in the nest at Glendale sub-station May 16, 1938, was trapped at my home station, less than a mile west, on July 7, 1938, February 23, 1939, and July 5, 1939. Female No. 37-240877, banded in the nest at Peabody Campus August 4, 1937, was found injured August 14, 1941, within a half-mile of the campus. Female No. 40-258298, banded in the nest August 6, 1941, was found dead in September, 1942, a quarter of a mile away. Male No. 41-217453, banded in the nest May 7, 1942, was found dead August 13, 1943, three-quarters of a mile southwest.

Dead Cardinals would not be easily overlooked by the public, yet not one of the 1,621 individuals banded in this area since 1931 has been reported except from the neighborhood of my banding stations.

In my experience there is no other bird that attacks the band as the Cardinal does. I have had to replace several tempered aluminum bands

that had been over-lapped by pressure from the beak of the wearer. An extraordinary example of the antipathy of a male toward his band which continued, at least spasmodically, over a period of two years, is described by J. B. Young (1941:197), of Kentucky. Mrs. Nice in Ohio and J. Van Tyne in Michigan each have evidence of at least one banded Cardinal that had removed the band. Although I have notched rectrices of numbers of my banded Cardinals—which would identify the individuals between molting seasons—none has yet been retaken without the band.

Ages of Banded Cardinals

Many of my birds have been retaken between the ages of two and three years but, disregarding those, the record shows that of the 1,135 individuals that at this time (1943) could have had a life span of three or more years, 30 birds, or 2.6 per cent, have lived three to six years. Age 3 years: 7 males, 5 females; age 3½ years: 1 male, 3 females; age 4 years: 3 males, 4 females; age 4½ years: 1 male, 1 female; age 5½ years: 3 males; age 6 years: 2 males.

Scott Hutcheson (1943:40) of Memphis, Tennessee, reports a banded male that nested near his home from 1939 to 1943, when it was found dead, at least five years old. Karl E. Bartel (1942:14), of Blue Island, Illinois, who had banded 73 Cardinals between 1935 and the end of 1941, states (p. 12) that his oldest living Cardinal is at least six years of age. Josselyn Van Tyne (1943:195) records a male in Michigan banded December, 1934, and still alive in August, 1943, at least nine years old. S. P. Baldwin banded an adult male Cardinal March 28, 1921, at Thomasville, Georgia, and captured it there in several successive seasons until February, 1930, when it was at least 10 years old (Lincoln 1933:86). M. S. Mercur (1937:122) had a female Cardinal in her garden in Pittsburgh, Pennsylvania, from the winter of 1927 until August, 1936, when it was found dead, at least 10 years old. Describing the old bird at the time of death, she states it "was disfigured by two bulbous growths, each more than half an inch through, that sprang from the base of the beak on either side and encroached both upon the nostrils and upon the eyes."

In Nashville, Tennessee, A. F. Ganier (1937:15) banded a male Cardinal in February, 1924, that lived to be at least 13½ years old (it was last seen in November, 1936). Ganier says: "When feeding at his shelf he does not stand erect . . . as do the younger Cardinals. Instead, he crouches or even sits down while eating. His head is held resting on his shoulders so constantly that when the neck is occasionally straightened, the feathers do not fall to cover the gap and a bare section of the neck is exposed. Molting has become slow and tedious; at this writing [November 10, 1936], there is still a ragged appearance on the upper breast." The Cardinal at the Ganier home mated and reared

young at that advanced age, but the female described by Mercur was deserted by her mate and apparently did not acquire another during her last season.

Weights

From 95 weights of Cardinals taken by Baldwin and Kendeigh (1938:438) in Ohio, the monthly averages show maximum weights prevail from October through April. In the records of 183 adults I took in Tennessee, maximum weights occurred from October through February. The loss in weight is correlated with the breeding season, which in our milder climate starts earlier in the year. Among the Ohio birds, the greatest weight, 50.3 grams, was recorded in January for the single female weighed that month; the lowest occurred in August, when seven females averaged 37.9 grams. In Tennessee, highest weights were also found in January, when 37 males averaged 48.4 grams; the lowest were in April, when 5 females averaged 39.3 grams; the average weight of 85 males was 45.1 grams, which is 2.1 grams greater than the average weight of 98 females, 43 grams.

Abnormalities

I have found Cardinals, both nestlings and adults, and their nests singularly free from ecto-parasites. Nests and individuals of many other species in the area, including the Mockingbird, Brown Thrasher, Catbird, Bluebird, and Towhee, have been found heavily infested with mites, mallophaga, and ticks, but I have found only one Cardinal with mites, a male about six weeks old, trapped in August, 1940. Mrs. Nice tells me by letter of a fledgling trapped in Ohio, which was heavily infested with mallophaga. Ruth H. Thomas (1941:591), of Arkansas, reports trapping three Cardinals parasitized by ticks. Bayard H. Christy (1942: 182) found one nest in Pennsylvania which contained maggots and pupae of *Protocalliphora*.

My Cardinals were almost immune to the foot and tarsus diseases found frequently in other fringillids, particularly Towhees, and Field and Chipping Sparrows. Four Cardinals had small, wart-like growths on toes. These were either removed or treated with iodine or mercurochrome. Two of these Cardinals were retrapped later with no trace of the affliction visible; the growths of one of these had been removed, the other had been treated with iodine. Two individuals had suffered tarsal injuries; one had an injured heel joint, the other, a broken tarsus, healed in an abnormal position, so that it was crooked and lumpy. Several had damaged mandibles, four of which appeared to have been caused by biting hard materials. Cardinals use their beaks, in moments of stress, to grasp with a vise-like grip (Laskey, 1934:115). When one is removing them from a banding trap, they grip the wires of the cage, and any bander will testify to the need of care in handling this

species to avoid painful pinching of fingers. The birds clamp the strong beak over the fingers in a grip that is difficult to unlock. This seems to be a fear reaction rather than a fighting gesture, for a small article placed in the bird's beak is often retained and the bander's hand ignored. An immature male had a deformed upper mandible, abnormally pointed at the tip, with a dark, thickened area at the base. The lower mandible of one male was marred by an injured spot measuring 8 by 3 millimeters. A female had the lower mandible abnormally short and, in the center, dark colored as if decaying. Another male had lost a large portion of the upper mandible. Two birds were trapped with slightly injured eyes, cause unknown. In summer, a male, blinded in one eye, was seen feeding on the ground. A tuft of dislodged head plumage indicated a possible attack by a predator.

Abnormal feather loss in a male Cardinal at least eight years old has been described by Van Tyne (1943:195). This bird lost all feathers from head and neck in June, and remained bald all summer but lived normally. In September he grew a complete set of head feathers in 28 days, remaining fully feathered, at least during the following ten and a half months. Van Tyne mentions a bald specimen from Texas, several in Ohio, and two of mine. Inadvertently, incomplete data were sent to him on my records. Instead of two cases of baldness among the 1,621 Cardinals banded, there are seven. One female had the head completely bald during August molt, normal in December; a female was bald, except for the crest on July 10—she was not retaken. A young female was reported from a sub-station with head bare on October 22 but was apparently normal in December. A male, banded in October with new plumage about complete, was retaken the following May with feathers missing from the right side of the head. He seemed very wild and bit frantically at my fingers. On June 11, he was completely bald and was still in that condition when retrapped July 14. His next recapture occurred in January, when his plumage was normal, though his beak was damaged at the edges. In two cases, some data have been gathered that may account for the feather loss. One male, while in a banding trap on November 13, was attacked by a cat through the wires, and received a scalp injury. When the bird was re-trapped a few days later, the wound appeared to be healed, but the bird was bald. A female was brought to me in late March with an injured wing. A week later, having regained some flight power, she was released. She was attacked and chased by a mated female on whose territory she trespassed. Two days later, she was found in another section of our place, partly bald. Apparently when Cardinals lose their head feathers prematurely through accident, they are not replaced until the normal season for plumage renewal in autumn.

No Cardinal with even a trace of albinism has been found among my birds, but Harry Yeatman (1942:18), of Mt. Pleasant, Tennessee,

reports seeing a partial albino in the winter of 1940. J. B. Loefer (1941: 44) lists one all white, and for Tennessee an albino female with two albino young, "all white except for a coral tinge to the wings." Maurice Brooks (1934:1) describes a partially melanistic male whose head, including the throat and nape of the neck, was "shiny blue-black" with one abnormally elongated red feather in the crest.

Summary

The Cardinal was studied in the Nashville, Tennessee, area from 1931 to 1943, a total of 1,621 individuals being banded.

Young Cardinals begin to sing a distinctive warbling song at three or four weeks of age, and use phrases of adult song at least by the age of two months.

Cardinals have at least 28 different songs, but male and female song are indistinguishable.

Cardinal song may sometimes be heard the year round, but full song for the male usually extends from February to September, and for the female, from March until July or August.

Whisper singing, antiphonal singing, and night singing are all common with Cardinals.

Cardinals begin late in February to take up territory and choose mates.

Each sex defends territory against intruders of its own sex, but Cardinals as a rule show little belligerence.

The female of a pair tends to follow her mate throughout the winter.

Males are mildly dominant over the females during the winter months.

The male feeds the female during courtship and the first nesting.

Nesting, as a rule, begins in April, sometimes in March, and frequently extends into September.

The nest is usually built by the female alone; all incubation and brooding is by the female; the male assists in feeding the young and in nest sanitation, taking full charge of fledglings when the female proceeds with another nesting.

Four nestings in a season are not uncommon.

The usual clutch is three eggs; eggs hatch 12 or 13 days after the last egg is laid; young leave the nest from 7 to 11 days, usually 9 or 10 days, after hatching.

There is some parasitism by Cowbirds.

Banding records indicate that individuals remain in the same garden for breeding and wintering for several years, and an individual rarely if ever wanders farther than four miles from its birthplace.

The winter groups or flocks (of 6 to 25 individuals) are apparently composed chiefly of young of the year.

Of 1,135 Cardinals whose life span could have been three or more years, 30 (2.6 per cent) have reached the ages of three to six years, the

oldest female being 4½ years old; two males reached the ages of six years. A male and a female 10 years of age and a male 13½ years are cited from the literature.

Weights of Tennessee birds are compared with those of Ohio birds.

Only one Cardinal was found with ecto-parasites; a few were found with injured beaks, feet or eyes; seven cases of baldness were recorded; no albinism or melanism was found.

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